Base Year: 1999 By: S. Claire

SOURCE INVENTORY

CATEGORIES # 441 - 444, 446 - 453, 455

GENERAL AVIATION AIRCRAFT, JET

1999 EMISSIONS

Introduction

Considered in these categories are emissions from gas turbine (jet) engines from general aviation aircraft during their operations at various airports in the Bay Area. The engine consists of a compressor, a combustion chamber and a turbine. Air entering the forward end of the engine is compressed and then heated by burning fuel in the combustion chamber. The engine uses its fan to accelerate additional air around the outside of the engine producing exhaust gases for efficient propulsion.

Normal flight and ground operation modes of the aircraft constitutes the landing/takeoff (LTO) cycle. The LTO cycle is grouped into five modes, which is equivalent to two operations in an airport activity. These include:

1. Startup, idle and taxi out,
2. Takeoff,
3. Climb out to about 2,300 feet--this height is considered the average mixing depth in the Bay Area and assumed inversion height, wherein aircraft exhaust emissions are released below it,
4. Descent/approach from 2,300 feet, touch down, and landing run, and
5. Taxi in, idle and shutdown.

There are numerous types of aircraft in use today. Aircrafts considered in these categories include only those believed to be in significant numbers at present or over the next few years.

Methodology

The number of operations and fleet mix were obtained from the airports in the Bay Area and the Metropolitan Traffic Commission (MTC). The LTO cycle has its equivalent operating time-in-mode (TIM) which is the time for a particular aircraft to go through each of the five modes (see AP-42, Table II-1-3). Composite modal emission rates (MER) for each of the various types of aircraft engines now in general aviation use were developed from various references on aircraft engine tests (see AP-42, Table II-1-7). Emission rates vary according to engine type and operating mode.

Emission factors for a specific aircraft were estimated by the equation:

$$\text{Emission Factor} = N \times E(v_e/v_t)m,p \times TIM$$

N = no. of engines
$(v_e/v_t)m,p$ = engine emission rates, lb/hr at mode m, pollutant p
TIM = time in mode, hr.

Estimates of aircraft mix for each of the airports were developed based on historical activity and data on home-based aircraft.

Sample calculations:

Data: OAK: 7,942 LTO/yr. (for Cat #443, Cessna Citation Jet)

Emissions = 7,942 LTO/yr x 1.82 lbs/LTO / 365 day/yr / 2000 lbs/T
= 0.02 ton/day of organics

Monthly Variation

Monthly distribution was based on the number of monthly operations at each airport.

County Distribution

Emissions were distributed to the county location of each airport, where SFO is in San Mateo County, OAK is in Alameda County, SJC in Santa Clara County, and to about a dozen smaller airports with jet aircraft activities in their corresponding counties.

TRENDS

History

Emissions through the years were estimated based on the above methodology and from the actual number of operations for each airport.

Growth

Projection for the number of operations is in accordance with MTC's "Regional Airport System Plan Update" (1994 and 2000). For the three major airports, SFO, OAK, and SJC, selected years were calculated with corresponding estimates of the aircraft fleet mix during those times. Emission values for other years were obtained by interpolation.